

**OPTICAL CURSOR CONTROLLER WITH AN OPERATING LENS
BACKGROUND OF THE INVENTION**

1. Field of the Invention

The invention relates to an optical cursor controller,
5 more particularly to an optical cursor controller with
an operating lens that permits movement of an object
thereon.

2. Description of the Related Art

A conventional optical mouse includes a housing, a
10 light source, a converging lens, and a light processing
unit. The housing has a lower side for moving on a mouse
pad, and an upper side for grasping by one hand of the
user. The lower side of the housing is formed with a
light hole therethrough. The light source is mounted
15 in the housing and is operable so as to radiate light
that is directed to the light hole in the lower side
of the housing. The light radiated by the light source
is reflected by the mouse pad and contains an image of
the mouse pad. The converging lens is mounted in the
20 housing and converges the reflected light. The light
processing unit is mounted in the housing, and includes
an image sensor and an image processor. The image sensor,
which is a charge-coupled device, receives the converged
light. The image processor monitors the image of the
25 mouse pad captured by the image sensor from the converged
light to detect movement of the conventional optical
mouse on the mouse pad, and generates cursor control

signals in accordance with the detected movement. The cursor control signals are subsequently provided to an external device, such as a computer, to control position of a cursor on a display screen of a display module of the external device.

The aforesaid conventional optical mouse is disadvantageous in that it requires a relatively large space to operate upon, and that repetitive movement to operate the conventional optical mouse requires hand-intensive activities that can cause wrist strain injuries.

SUMMARY OF THE INVENTION

Therefore, the object of the present invention is to provide an optical cursor controller that can overcome the aforesaid drawbacks of the prior art.

According to the present invention, an optical cursor controller comprises an operating lens, a light source, and a light processing unit. The operating lens has an operating surface that permits movement of an object thereon. The light source is operable so as to radiate light that is directed to the operating lens. The reflected light reflected by the object on the operating surface contains an image of the object on the operating surface. The light processing unit receives the reflected light, monitors the image of the object contained in the reflected light to detect movement of the object on the operating surface, and generates cursor

control signals in accordance with detected movement of the object on the operating surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings, of which:

Figure 1 is a schematic partly cutaway view of the first preferred embodiment of an optical cursor controller according to the present invention;

Figure 2 is a schematic view to illustrate an operating lens of the first preferred embodiment;

Figure 3 is a block diagram illustrating a light processing unit and a peripheral controller of the first preferred embodiment;

Figure 4 is a perspective view of the second preferred embodiment of an optical cursor controller according to the present invention; and

Figure 5 is a perspective view of an electronic apparatus that is integrated with the third preferred embodiment of an optical cursor controller according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figures 1 to 3, the first preferred embodiment of an optical cursor controller 100 according to this invention is shown to include a housing 1, an operating lens 2, a light source 3, and a light processing

unit 5.

The optical cursor controller 100 is operably associated with a display module 80 for generating cursor control signals that control position of a cursor (not shown) on a display screen of the display module 80. The display module 80 is connected electrically to a host module 60 of a computer system. The display module 80 may be the display unit of one of a desktop computer, a notebook computer, a tablet personal computer, and a personal digital assistant.

The housing 1 is formed with a lens-mounting hole 11 therethrough. The lens-mounting hole 11 is confined by a hole-defining wall. The housing 1 has a lower side 13 adapted to be placed on a support (not shown), such as a table, and an upper side 12 adapted for placing a user's hand (not shown) thereon. The lens-mounting hole 11 is formed in the upper side 12 of the housing 1 at a position within reach of a finger 50 on the user's hand.

The operating lens 2 is mounted in the lens-mounting hole 11. In particular, the operating lens 2 has an operating surface 21 accessible from an exterior of the housing 1, an inner surface 22 that is opposite to the operating surface 21 and that faces an interior of the housing 1, and a periphery that interconnects the operating and inner surfaces 21, 22 and that is secured to the hole-defining wall. The operating surface 21 of

the operating lens 2 permits movement of the finger 50 thereon. The operating lens 2 may be a transparent glass, plastic, or resin. In this embodiment, the operating and inner surfaces 21, 22 of the operating lens 2 are
5 convex and flat surfaces, respectively. The construction as such permits the operating lens 2 to create a magnifying effect.

The light source 3 is mounted in the housing 1 and is operable so as to radiate light that is directed to
10 the operating lens 2. The radiated light undergoes refraction several times and then passes through the operating lens 2. At this time, when the finger 50 of the user is on the operating surface 21 of the operating lens 2, the radiated light is reflected by the finger
15 50 and thus contains an image of the finger 50. In this embodiment, the light source 3 includes a light emitting diode that radiates red light at a wavelength of 639nm. In an alternative embodiment, the light source 3 includes a light emitting diode that radiates blue light at a
20 wavelength of 875 nm.

The light processing unit 5 is mounted in the housing 1, and includes an image sensor (not shown) and an image processor (not shown). The image sensor receives the reflected light. In this embodiment, the image sensor
25 has a frame rate of 1500 frames per second, and is in the form of a charge-coupled device (CCD). However, it should be apparent to those skilled in the art that a

complementary metal-oxide semiconductor (CMOS) may be used as well. The image processor monitors the image of the finger 50 contained in the reflected light to detect movement of the finger 50 on the operating surface 21 of the operating lens 2, generates cursor control signals in accordance with detected movement of the finger 50 on the operating surface 21 of the operating lens 2, and includes an optical sensor, such as the ADNS-2051 optical sensor available from Agilent, and a digital signal processor (DSP).

The light source 3 and the light processing unit 5 are mounted on the same printed circuit board 7 to facilitate assembly.

The optical cursor controller 100 further comprises a converging lens 4 mounted in the housing 1 and disposed between the operating lens 2 and the light processing unit 5 for converging the reflected light prior to receipt thereof by the light processing unit 5. Preferably, the converging lens 4 is implemented using the HDNS-2100 lens available from Agilent.

A peripheral controller 30 is connected electrically to the light processing unit 5. The peripheral controller 30 converts the cursor control signals generated by the light processing unit 5 into output signals that control the position of the cursor on the display screen of the display module 80. The output signals generated by the peripheral controller 30 are transmitted to the host

module 60 of the computer system through a USB cable (not shown). Preferably, the peripheral controller 30 is implemented using a CY7C63723A-PC USB peripheral controller available from Cypress.

5 Although the peripheral controller 30 is exemplified using a USB peripheral controller, it should be apparent to those skilled in the art that a wireless peripheral controller (e.g. 802.11a, 802.11b, bluetooth, etc) may be used as well. As such, the cursor control signals
10 generated by the light processing unit 5 can be transmitted to the host module 60 of the computer system wirelessly.

 The optical cursor controller 100 further includes a mouse button unit 6 disposed on the upper side 12 of
15 the housing 1. The mouse button unit 6 enables generation of mouse control signals, in a known manner, when operated.

 It is noted that to obtain optimum focal length, the operating surface 21 of the operating lens 2 and the
20 light processing unit 5 must be spaced apart at a distance (d) that ranges from 7.30 to 7.60 millimeters along an optical axis. The distance (d) is 7.45 millimeters in this embodiment.

 Moreover, the magnifying effect of the operating lens
25 2 enhances sensitivity of the light processing unit 5 to the movement of the finger 50 on the operating surface 21 of the operating lens 2. In this embodiment, a good

result is obtained when the operating lens 2 has a thickness not greater than 2 millimeters and a magnifying power ranging from 1 to 6 times.

Further, although the operating lens 2 is exemplified as having an inner surface that is flat and an operating surface that is convex, operating lenses of different shapes and sizes with different magnifying or reducing powers may be used as long as the object of this invention is achieved.

Figure 4 shows the second preferred embodiment of an optical cursor controller 100 according to the present invention. This embodiment differs from the previous embodiment simply in that the operating lens 2 is mounted in a lateral part of the upper side 12 of the housing 1 so as to be accessible by the thumb (not shown) of the user's hand.

Figure 5 shows the third preferred embodiment of an optical cursor controller 100 according to the present invention. In this embodiment, the optical cursor controller 100 is integrated into an electronic apparatus 200, such as a notebook computer.

The electronic apparatus 200 includes a display module 80 with a display screen, and a host module 60 connected pivotally and electrically to the display module 80 and provided with a keyboard 70 thereon. The optical cursor controller 100 is mounted on the host module 60 such that the operating surface of the operating

lens 2 is accessible from an exterior of the host module 60. In other words, the host module 60 serves as the housing of the optical cursor controller 100 in this embodiment.

5 It has thus been shown that the optical cursor controller 100 of the present invention includes an operating lens 2 that permits movement of a finger 50 on a user's hand thereon, a light source 3 that is used to generate reflected light containing an image of the
10 finger 50, and a light processing unit 5 that generates cursor control signals in accordance with detected movement of the image of the finger 50 on the operating lens 2. The arrangement as such allows the user to control the position of a cursor on the display screen of the
15 display module 80 without moving the optical cursor controller 100. In other words, the user simply needs to move his finger 50 on the operating lens 2 for cursor control. As such, unlike the conventional optical mouse, the optical cursor controller 100 of this invention
20 remains stationary and does not require a relatively large space to operate upon. Moreover, since the optical cursor controller 100 of this invention does not need to be moved repeatedly, wrist strain injury can be avoided during use. Further, the components in the conventional
25 optical mouse, with the addition of the operating lens 2, can be employed to implement the optical cursor controller 100 of this invention.

While the present invention has been described in connection with what is considered the most practical and preferred embodiments, it is understood that this invention is not limited to the disclosed embodiments
5 but is intended to cover various arrangements included within the spirit and scope of the broadest interpretation so as to encompass all such modifications and equivalent arrangements.